Multifamily Domestic Hot Water

Statewide Codes & Standards Program

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Summary of Proposals

- Central Water Heating Budget
  - Currently, MF buildings with central water heating are compared to buildings with 0.52EF 50 gallon water heaters in every apt.
  - Proposal: compare like to like
- Distribution System Multipliers
  - Currently, pipe losses underestimated in ACMs
  - Currently, only temp. control receives credit
  - Proposal: new multipliers for distribution system, and distribution system controls

Distribution Losses

Project No.	CZ03	CZ07	CZ09	CZ12
#2	16.9%	15.4%	15.0%	15.5%
#11	15.0%	14.1%	13.5%	13.4%
#13	25.0%	23.6%	22.4%	22.8%

- … as a percentage of total building energy use.

Project No.	CZ03	CZ07	CZ09	CZ12
#2	28.8%	29.5%	29.8%	29.2%
#11	26.8%	27.4%	27.7%	27.1%
#13	38.6%	39.2%	39.4%	38.9%

- … as a percentage of DHW energy use.

Prescriptive Requirements Traded Off due to the Central Water Heating Loophole

	Size (sq.ft.)	700	900	1100
	Prescriptive	Trade-off Results		
Insulation				
Ceiling	R-38	R-19	R-19	R-30
Walls	R-19	R-13	R-13	R-13
Floor	R-19	R-13	R-13	R-19
Radiant Barrier Attic	Required	NONE	NONE	NONE
Glazing				
U-factor	0.65	0.65	0.65	0.65
SHGC	0.4	0.4	0.4	0.4
Heating Efficiency	Appliance Stds Minimum	Minimum	Minimum	Minimum
Cooling Efficiency	Appliance Stds Minimum	Minimum	Minimum	Minimum
TXV	Required	NONE	NONE	NONE
Ducts Sealed	Required	NOT	NOT	NOT
DHW Budget	[(16370/CFA) + 4.85] (in kBtu/sf-yr)	28.2	23.0	19.7

Other Scenarios:

- Single glazed aluminum windows
- Electric resistance heat

Annual Water Heating Budget Equation for Multifamily Buildings with Central DHW

$$AWBc(kBtu/yr \cdot sf) = \frac{\sum_{x=1}^{i} n_x \left[\left(C_{CZ} / CFA_x \right) + Y_{CZ} \right]}{\sum_{x=1}^{i} n_x}$$

- X = (size) category for dwelling units (unitless number)
- CFA_x = conditioned floor area of dwelling units of size category X
- n_x = number of dwelling units of size category X
- C_{CZ} = a constant that varies by Climate Zone
- Y_{CZ} = a constant that varies by Climate Zone

Hourly Water Heating Calculation for Central DHW Systems in MF

- Relatively simple to adapt the analysis that's already done.
- Same assumptions for budget:
  - minimum efficiency boiler
  - recirculation loop
  - time control (off at night)
  - minimum insulation
  - 95% of loop within envelope

Analysis Methodology

- Select building prototypes
- Hourly hot water loads (gallons/hr)
- Distribution lengths and UA
- DOE 2.2 model
  - as designed
  - minimums per standards
  - reasonable assumptions

Base Case Assumptions

- Minimum efficiency boiler
- 95% of distribution piping w/i envelope
- Pipe insulation per Table 1-T (Section 150)
- Recirculation pump
- Time control (7 hours off/night)
- Pipe/pump sized for maximum draw

Distribution Measures Analyzed

- Increased pipe insulation
- Location of distribution piping
  - envelope
  - ambient
  - underground
- Time controls
- No controls
- No re-circulation pump
- Separate laundry center

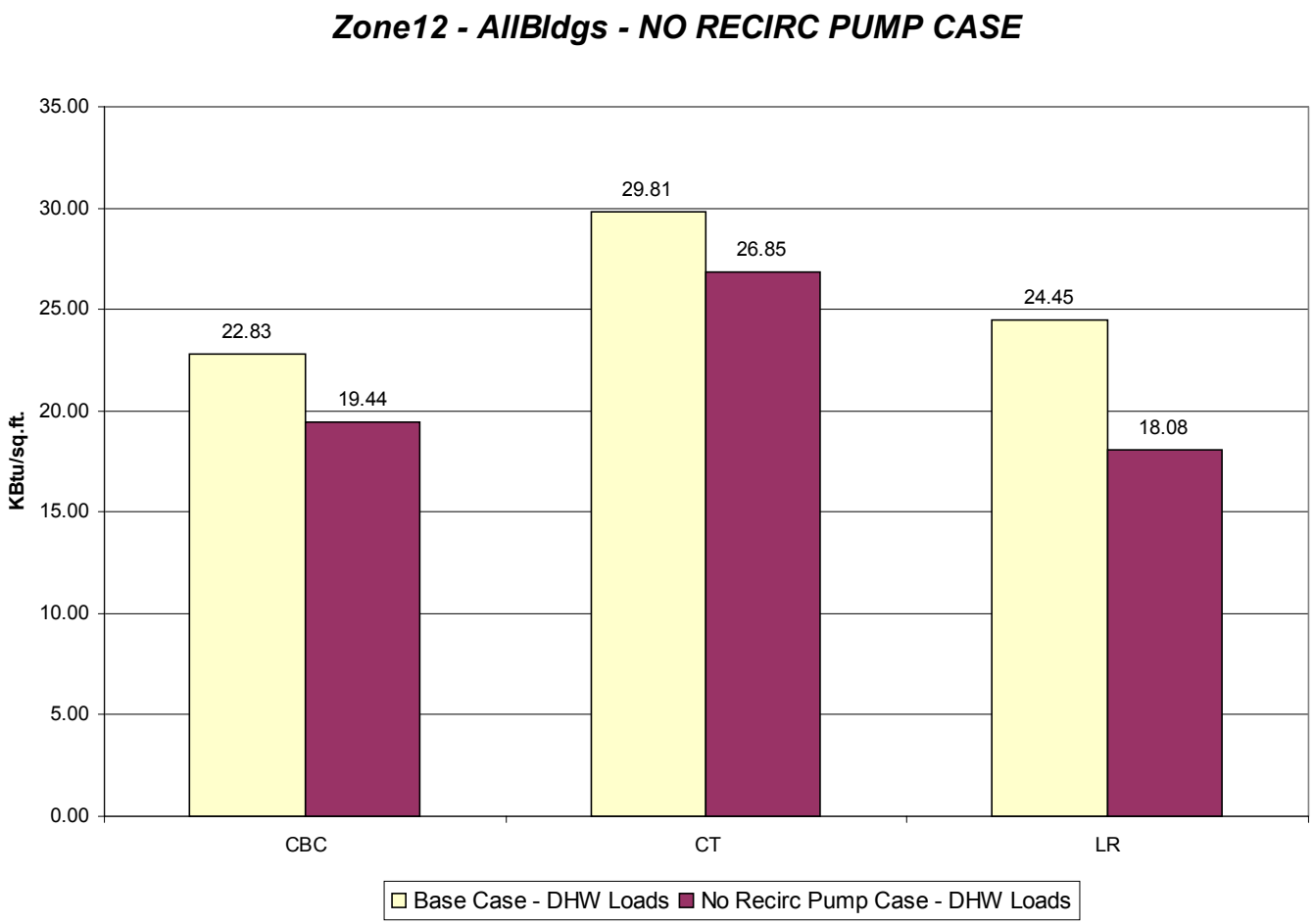
Measures To Be Analyzed

- Temperature Control
- Time/temperature controls
- Demand control

Distribution Losses as a Percentage of Total DHW Energy

Project No.	CZ03	CZ07	CZ09	CZ12
#2	16.9%	15.4%	15.0%	15.5%
#11	15.0%	14.1%	13.5%	13.4%
#13	25.0%	23.6%	22.4%	22.8%

Re-circulation Related Losses



Circulation Losses

Building	Base Case		Difference From Base Case			
			No Pump		Pump/No Control	
	Pipe Losses	Total DHW	Pipe Losses	Total DHW	Pipe Losses	Total DHW
#2	8.70	29.81	26.8%	9.9%	-17.4%	-6.2%
#11	6.19	22.83	39.4%	14.9%	-22.7%	-8.2%
#13	9.51	24.45	53.8%	26.1%	-30.9%	-14.3%

Recommendations

- Separate Central DHW Budget
- Credits for Controls
- Multipliers for:
  - Pipe location
  - Pipe insulation
  - Separate laundry facilities